KEY PRACTICE

Youth Engage with Complex Social-Ecological Systems

YOUTH ENGAGING WITH COMPLEX SOCIAL-ECOLOGICAL SYSTEMS (SES) involves young people observing, considering, and acting within the human and natural systems around them. YCCS work often asks young people to look closely, with new tools and new eyes, at nearby landscapes. Even when this gets messy, YCCS can be an important way to help students understand that human activity makes up an integral part of ecological systems, with both positive and negative effects. This makes it easier to see the role that they, their neighbors, and their governments play in complex socio-ecological systems. *See figure: Elements of a social-ecological system.*[1,2]

Key practices for youth in youth-focused community and citizen science (YCCS) can lead young people to be more motivated and engaged in scientific practice, see themselves as part of scientific and local communities, broaden possible career paths, and foster youth agency with environmental science.

Why it's good for learning

In contrast to "known answer" questions and classroom-based inquiry that treat nature as static systems, an SES model treats ecological processes as ever-changing. It encourages young people to understand feedback cycles. For example, restoration of a natural area may increase the attractiveness of an outdoor area, resulting in higher visitation and intensified human impacts on the environment. A perspective on the natural world that includes human influence and long-term processes can reveal ways that small actions, like restoring native species or talking to neighbors about beach activity, can generate positive change[3]. Engaging directly with issues on the ground can also help to counter narratives of fear around climate change and pollution that do little to encourage youth action[4]. Deeper engagement with the complexity of ecological systems is needed to prompt young people to think in depth about environmental stewardship[5], and move beyond the superficial[6].

When youth participate in science investigations that also examine human behaviors and community concerns, they are able to draw on funds of knowledge[7] built outside the classroom to engage in complex scientific reasoning. For example, they may integrate evidence about how a neighborhood is perceived by the community, or consider what strategies for collective action might be most effective[8]. Further, both learning and scientific research can be strengthened when people's connections to place are activated and they come to see the many levels of activity that overlap, from hidden organisms and biological processes, to human activity like community stewardship events, scientific research and family outings, to policies and climate conditions that shift at a large scale[9].

Case Study: Weighing human and environmental challenges

When students at Cross City High School began to

study the lake just blocks from their school, they were surprised that they had to go back over and over to the lake, doing the same thing each time: testing water samples for levels of phosphate, nitrate and ammonia. "We already did this," claimed one, while another saw it as repetitive and a little boring. Three months later, after the group had analyzed and written up what they found over that time period, a number of students admitted that going back each week was the most interesting part of the project. They noticed that lake health varied over time, as did human activities surrounding the lake. They noticed that levels of ammonia were high in several areas and phosphate levels occasionally spiked.

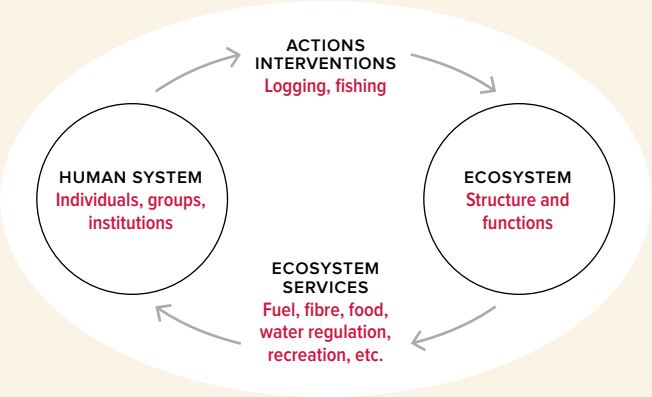
While collecting the water quality data, they paid attention to the homeless encampments that were near some of the sampling sites, and hypothesized that increased levels of ammonia could come from these encampments, as well as from upstream sources. In class, the group discussed when and why the encampments were there, how storm drains and topographic features may be moving waste into the lake, where and when public restrooms were available, and possible ways to address the problems. Students realized any proposed actions to support both the health of the lake and the health of people would face difficulties. The students brought their findings to city representatives, environmental scientists and local advocacy groups, and talked about possible solutions. These conversations further increased their understanding of the complexities of urban ecosystems, leading students to consider how to simultaneously address social and environmental problems.

Tips for Implementing

1. **Environmental science questions can be studied in urban areas.** Many projects bring students face to face with the ways in which animal and plant life are intertwined with human activity. Prepare a strategy for facilitating discussion of tough issues like homelessness and dumping. Create a shortlist of ideas for taking action (rather than leaving it entirely open-ended), resources for further investigation, or groups that are working on social and environmental issues.

FIGURE

Elements of a social-ecological system[1,2]



2. **Attend to unexpected events.** Whether by natural or human causes, discuss how such events are linked to other parts of the system.
3. **Listen for and draw out students' existing knowledge of a place.** Start with simple questions: Who comes to the place? Where does the water (or air, or trash) come from? Where do they go?
4. **Research the history of places you will investigate,** especially where human activity is less obvious. What might the landscape have looked like 100 years ago? What plants and animals would have been there? What signs of past human use are still visible? What policies or agencies influence the site? Students can create a web or chain to visualize these connections, or search for maps that show land-use change over time.
5. **Talk with people who impact, or are impacted by, the place you are studying.** These might include local government, neighbors, conservation professionals or volunteers, or local schools. Present findings to them, invite students to interview neighbors, or survey community members about their impressions of the place, or what kinds of activities they do there.
6. **Encourage students to "tune in" their senses when outside.** Human senses are still some of the most powerful instruments for the collection of scientific data. How does what students know and sense about a place add to, or contrast with, other sources of data?

[1] Berkes, F., Colding, J., & Folke, C. (Eds.). (2008). *Navigating social-ecological systems: building resilience for complexity and change.* Cambridge University Press.

[2] Adapted from *Ecological Systems: A Practitioner's Workbook*. Accessed August 1, 2017. wiki.resalliance.org/index.php/Level_2_Detail_-_Bounding_the_System:_Describing_the_Present.

[3] Ballard, H.L., Dixon, C.G., Harris, E.M. (2016). Youth-focused citizen science: examining the role of environmental science learning and agency for conservation. *Biological Conservation*.

[4] O'Neill, S. and Nicholson-Cole, S. (2009) "Fear Won't Do It": Promoting Positive Engagement With Climate Change Through Visual and Iconic Representations. *Science Communication*, 30(3).

[5] Tidball, K.G. and M.E. Krasny. 2010. Urban environmental education from a social-ecological perspective: conceptual framework for civic ecology education. *Cities and the Environment*. 3(1)

[6] See for example, Gould, R.K., Ardoin, N.M., Biggar, M. et al. (2016) Environmental Behavior's Dirty Secret: The Prevalence of Waste Management in Discussions of Environmental Concern and Action. *Environmental Management*, 58: 268.

[7] Gonzalez, N. (1992). Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. *Theory Into Practice*, XXXI, 2, 132-141.

[8] Calabrese-Barton, A, and E. Tan (2010) We Be Burnin'! Agency, Identity, and Science Learning. *Journal of the Learning Sciences*, 19(2).

[9] Haywood, B.K. (2014) A "Sense of Place" in Public Participation in Scientific Research. *Science Education*, 98 (1): 64–83.

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ABOUT THE YCCS PROJECT: Youth-focused Community and Citizen Science (YCCS) involves young people directly in the scientific production of knowledge. Beginning in 2013, a team based at the UC Davis School of Education has been studying YCCS projects in Northern California, and convening project designers, teachers, scientists and others involved in YCCS to generate and share knowledge of when and how YCCS works best. The YCCS project is part of the UC Davis Center for Community and Citizen Science. To learn more, please visit **education.ucdavis.edu/ccs**.